

Initial Programming

Initial Programming Overview

There are several basic programming steps that need to be done initially. These steps are necessary for controls that are installed on machines, and to a lesser extent apply to controls that are being tested “on the bench”. Initial programming of the following items, in the order they are presented, will avoid problems later.

If you are not already familiar with PLS control programming, it is recommended that pages 4-2 and 4-3 (Programming Introduction) of this manual be reviewed before proceeding. If you simply want to see outputs operate “on the bench”, connect DC input power, connect the resolver, plug in some output modules, and go to Step 8 on the next page.

Note: Flashing error messages will be displayed in response to programming errors and hardware problems. Pages 7-2 and 7-3 list all of the flashing error messages used by the PS-5144 controller and what corrective action should be taken when they occur.

Step 1 - Direction of Rotation

FCN 101 “dr” allows the control to be set for Clockwise (CL) or Counter Clockwise (CCL) rotation of the resolver (as viewed from front of resolver). In most applications it is desirable to have the position value increasing as the machine moves in a forward direction. The factory set choice is Counter Clockwise.

If the resolver is installed, simply monitor position (press POS/RPM key until POS LED on) and move the machine in the forward direction. If the position value increases, a programming change is NOT needed. If the value decreases, go into FCN 101 “dr” and select the opposite direction of rotation (see page 6-1).

Note: If an Electro Cam resolver is not being used, it may be necessary to program the resolver type chosen (FCN 101 “rt”). See page 6-3 for details.

Step 2 - Scale Factor

The Scale Factor (FCN 101 “SF”) is the number of position increments per resolver revolution. For most applications it is desirable to program and monitor position in degrees, so a Scale Factor of 360 is used (360 is the factory set value). Sometimes greater position accuracy is needed, so a larger Scale Factor is used. Page 6-1 details and illustrates how to program the Scale Factor.

Step 3 - Shaft Position

The PS-5144 stores and tracks the actual machine position and calls it “Shaft Position”. Once correctly set, the Shaft Position will always represent the actual position of the machine when running or stopped. To set Shaft Position, stop the machine in a known position and set FCN 101 “SP” equal to that position value. Shaft Position will serve as the position reference for FCN 6 offset values programmed later. Page 6-2 illustrates how to program Shaft Position.

Step 4 - Number of Analog Outputs

If analog outputs are going to be used, the number desired (0, 1, or 2) should be specified now in FCN 101 “nA”. It is not necessary to establish the analog offset(s) and full scale RPM values at this point, just the number of analog outputs needed. If no analog outputs are needed, insure that “nA” is set to 0 (0 is the factory setting). Page 6-2 illustrates how to program the Number of Analog Outputs.

Step 5 - Number of Output Groups

The PS-5144 can be subdivided into as many as six different groups of outputs. Each group can have a unique phase relationship to the machine and can interact with an input signal in operating Modes 1-5. If you are sure that your application will not use output grouping or modes, verify that FCN 108 is set for only 1 group of outputs (page 6-8) and that FCN 109 is set for Mode 0 (page 6-9), both factory settings. This will configure the control to perform standard cam output logic on all outputs, all outputs will be in phase with each other. Go to step 7 if output grouping and modes will not be used for your machine application.

If output grouping will be used, the next programming step is to establish the number of groups and the number of outputs in each of these groups. This is done by programming FCN 108 accordingly, which is illustrated on page 6-8. Also, detailed information on output grouping can be found on page A-2. When FCN 108 programming is complete, go on to step 6 below.

Step 6 - Modes of Operation for Output Groups

Each of the output groups established in step 5 above can be programmed to operate in any one of the six modes available (Modes 0-5). Mode selection programming is done using FCN 109, page 6-9. Additional information, which details the operation of each mode, is located in the Appendix. If you are not already familiar with the logic and programming of these modes, you should review these pages so your application can most effectively utilize the output logic that modes offer.

Step 7 - Offsetting Position(s)

Output group position(s) can be offset from the “Shaft Position” by programming either FCN 2 or FCN 6. Any output group(s) that are operating in Mode 1 or 2 will require FCN 6 to be set as a preset value. Output groups that are in modes 0, 3, 4, or 5 can be offset by programming FCN 2 equal to their desired position(s) when the machine is stopped, or by programming an amount of offset advance from “Shaft Position” using FCN 6. In these non-resetting modes, FCN 2 and FCN 6 will interact with each other - changing one will affect the value programmed in the other. Programming information for FCN 2 and FCN 6 are on pages 5-3 and 5-7, respectively.

In applications where all of the output groups have the same position relationship to the machine, setting the “Number of Group Offsets” to one will simplify programming and operation. FCN 101 “nO” (number of offsets) sets the number of group offsets as shown on page 6-2.

Initial Programming - Function Summary

Step 8 - Program Output On/Off Setpoints

At this point, the only essential programming step remaining is output setpoints. Determine the position values where each output should cycle “on” and “off” and program those values accordingly. If multiple programs (job recipes) are going to be used, pay attention to which program number the output setpoints are being programmed into. Information on programming output setpoints is located on page 4-4.

When all of the output setpoint programming is complete, the control system can be tested. The outputs should cycle on and off at the programmed position locations as the resolver turns through the cycle. If modes 2, 3, 4, or 5 are being used, outputs will be disabled unless the corresponding input conditions are met. Input windows must also be programmed for Modes 2, 4, and 5. Review page 6-9 and the Modes information in the Appendix if the input/window requirements are not clear at this time.

Step 9 - Take Advantage of All Features Available

The programming steps to this point have included only those steps that were necessary to get the machine basically running. There are many other control features that may be very beneficial to your application. For example, Speed Compensation (FCN 4), Timed Outputs (FCN 5) or Motion ANDing (FCN 107) may be appropriate for this application.

It will be necessary to review each controller function to determine which features should be utilized. Below is a summary of all of the PS-5144 functions. “**Operation Functions**” can be made accessible to operators and are programmed/adjusted periodically as needed. “**Configuration Functions**” are normally programmed during the initial setup and then left alone after they are set to best match the control's features to the application requirements.

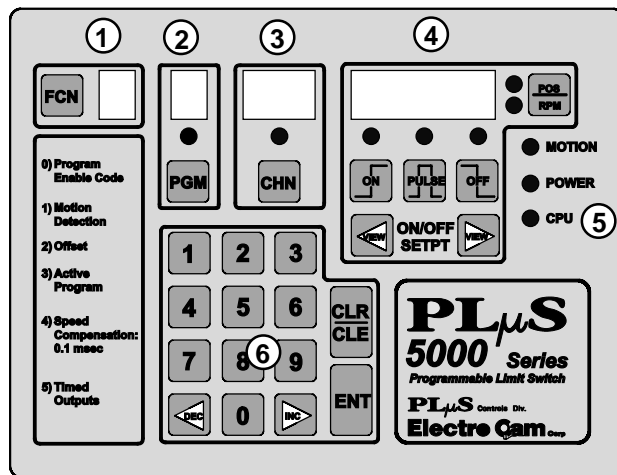
Operation Functions

FCN 0:	Program Enable Code (Programming Access)	FCN 6:	Absolute Offset
FCN 1:	Motion Detection	FCN 7:	Program Copy
	Lo - Low RPM Value for Speed Range		SP - Source Program
	Hi - High RPM Value for Speed Range		dP - Destination Program
	Ao - Analog Offset	FCN 8:	Pulse Generation
	AH - Analog High RPM Value		Pn - Program Number
FCN 2:	Offset (Position)		CH - Channel Number
FCN 3:	Active Program		on - Start Position of Pulse Train
FCN 4:	Speed Compensation		oF - End Position of Pulse Train
FCN 5:	Timed Outputs		ct - Count (number of pulses)
			du - On Duration of Each Pulse

Configuration Functions

FCN 101:	Unit Configuration #1	FCN 105:	Setup and Operator Enable Codes
	dr - Direction of Rotation		SE - Setup Enable Code
	SF - Scale Factor		OE - Operator Enable Code
	SP - Shaft Position	FCN 106:	Operator Functions and Outputs
	nA - Number of Analog Outputs		SP - Setpoints (Outputs)
	nO - Number of Group Offsets		Sd - Speed Detection (FCN 1)
	rt - Resolver Type		oF - Offset (FCN 2)
	PS - Program Select Format (Input)		AP - Active Program (FCN 3)
FCN 102:	Unit Configuration #2		Sc - Speed Compensation (FCN 4)
	Sc - Speed Compensation Type		to - Timed Outputs (FCN 5)
	tb - Time Base	FCN 107:	Motion ANDing
	gL - Gray Code Logic Type	FCN 108:	Subdividing Outputs into Groups
FCN 103:	Display Configuration	FCN 109:	Output Enable Modes
	dd - Display Default	FCN 110:	Outputs ANDed with Enable Input
	tr - Toggle RPM	FCN 111:	Channel Setpoint Memory (monitor)
	ru - RPM Update (Rate)		
FCN 104:	Communication Parameters		
	ct - Communication type		
	cS - Communication Speed		
	cA - Communication Address		

Keyboard Layout, Keys and Indicators



① - Function Key and Display

The **FCN Key** is used to access the control's functions. An "F" will be displayed during function programming. During normal operation, when Position or RPM are indicated, a "P" will be displayed as the first letter of the abbreviation "Pn" which represents program number.

② - Program Key, LED and Display

The **PGM key** is ONLY used to view or edit inactive programs. During normal operation, when Position or RPM are indicated, an "n" will be displayed as the second letter of the abbreviation "Pn" which represents program number. **When "Pn" is displayed, the number shown in the CHN display is the current active program.** When an inactive program is selected for viewing/editing, a "-" (dash) will be shown in the PGM display.

③ - Channel Key, LED and Display

The **CHN key** allows the desired output channel to be selected for setpoint viewing/programming. The selected channel number is shown in the display directly above the CHN key (decimal points will be lit if channel has more than 1 pulse). When the CHN LED is lit, the channel currently selected is in the ON state. During normal operation, when Position or RPM are indicated, the current active program number will be shown in CHN display following the "Pn" abbreviation. The CHN key is also used to select channel numbers during Function programming. Details are given in the programming sections.

④ - Value Display, Position/RPM Key and LEDs, ON Key and LED, PULSE Key and LED, OFF Key and LED, and View Keys

The **POS/RPM key** selects between Position and RPM being shown in the value display immediately to the left of the key. The corresponding POS or RPM LED will be lit when either item is displayed. **Pressing the POS/RPM key allows programming functions to be exited/aborted and returns the control to displaying Position or RPM.**

The **ON** and **OFF keys** are ONLY used to specify the ON and OFF pulse edges during setpoint creation (not adjustment). The corresponding ON and OFF LEDs will be lit during these setpoint programming operations. (The ON and OFF keys and LEDs are also used when programming the optional leading and trailing edge speed compensation feature).

The **VIEW keys** allow the current "on" and "off" setpoints of the currently selected channel to be displayed in sequence, one at a time (for monitoring and/or **adjustment**). The corresponding ON or OFF LED will be lit to indicate whether an ON or OFF edge is currently displayed. The >VIEW key displays the setpoints in increasing numeric order, the <VIEW key displays them in decreasing numeric order.

The **PULSE key** allows setpoint pairs (pulses) to be incremented and decremented simultaneously. When the PULSE LED is lit steady, the pulse (both edges) whose edge is currently displayed will increment and decrement when the INC and DEC keys are pressed. Pressing the PULSE key a second time will cause the LED to blink. This indicates that the multi-pulse mode is activated and all of the pulses in the currently selected output channel will increment and decrement when the INC and DEC keys are pressed.

⑤ - MOTION, POWER and CPU LEDs

The **Motion LED** is lit whenever the machine speed is within the current "Motion Level 1" setpoints (FCN 1).

The **Power LED** is lit whenever the control is powered up.

The **CPU LED** only lights when a Fatal error condition is detected by the controller. Power cycle the control to clear the error condition. Call Electro Cam if the error condition reoccurs.

⑥ - Numeric, CLR/CLE, ENT, INC and DEC Keys

The **number keys** are used to input all numeric values needed during setpoint and function programming.

The **CLR/CLE key** is used to clear numeric values during programming operations.

The **ENT key** is used to enter numeric values into the controller after they have been keyed in. Failing to press ENT when programming numeric values will result in the old value remaining in the controls memory. Numeric value changes must be "Entered" by pressing the ENT key before they are accepted by the controller.

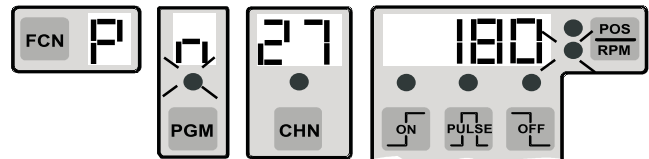
The **INC and DEC keys** cause numeric values that are displayed in the controls POS display to be incremented and/or decremented each time the corresponding key is pressed. Output setpoints, speed compensation and timed output values are examples of items that can be incremented and decremented using the INC and DEC keys.

Common Controller Displays

Examples of Common Displays

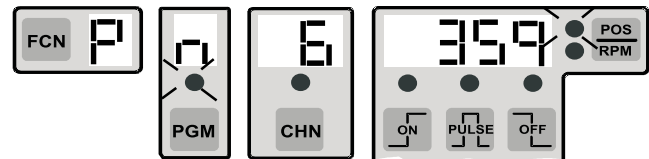
RPM Display

The display to the right shows that the current active program number is 27 and the current RPM is 180. The RPM LED is lit to indicate that the number shown is the RPM value.



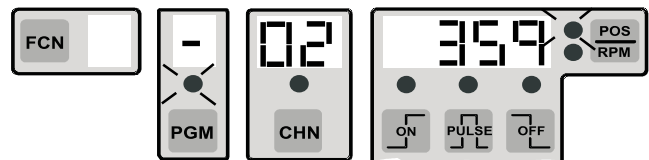
Position Display (1 Offset)

The display to the right shows that the current active program number is 6 and the current Position is 359. The POS LED is lit to indicate that the number shown is the Position value.



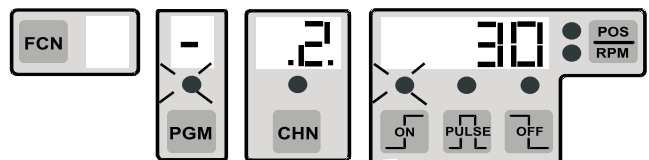
Position Display (Multiple Offsets)

The display to the right shows that the current Position of Output Group 2 is 359. The POS LED is lit to indicate that the number shown is the position value. When there is more than one offset value possible, the controller will step through each Output Group's position as the POS/RPM key is pressed before returning to the RPM display.



Output Setpoint Monitoring/Programming Display

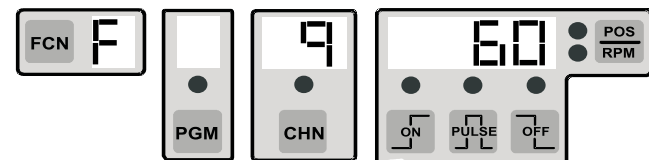
The display to the right shows that output 2 is programmed to turn on at 30. The decimal points in the channel display indicate that output 2 presently has more than one pulse programmed in it. When the decimal points are not on, the corresponding output does NOT contain multiple pulses. While the output setpoints are displayed, the CHN LED will be on when the corresponding output is on.



Function Programming Display

The display to the right shows that Function programming is being accessed ("F" in FCN display). The information shown in the other displays will vary according to the specific function being programmed.

Press the POS/RPM key to exit or abort function programming and return to a Position or RPM display mode.



Programming Access Levels

Levels of Programming Access

The 5000 Series of controls have three levels of programming access. This protects the programmed contents in the controls by allowing personnel with different degrees of program responsibility to access those features they need to adjust, while restricting them from others. Entry into these levels of programming is accomplished through dedicated hardware inputs and/or programmable enable codes entered through the keyboard. Brief descriptions of these programming access levels are as follows:

Master Level - Accesses all programmable features. In addition to all control related setpoints and functions, the "Master" level allows the keyboard entry codes for the "Setup" and "Operator" access levels to be established/changed. Master level programming also establishes which Functions and outputs are accessible to the operator (FCN 106).

Setup Level - Accesses all output setpoints and the Functions listed on the keyboard front panel. These are control aspects that may need occasional adjustment, but go beyond normal "Operator" responsibilities.

Operator Level - Accesses the Functions and output numbers, including setpoint programming, specified by "Master" level programming (see FCN 106 for details). Any combination of the "Setup Level" functions and output

numbers can be made available to operators.

The table below details which functions and set points can be changed at the 3 levels of programming access. It also indicates if the programming access levels can be accessed by hardware input and/or keyboard enable code.

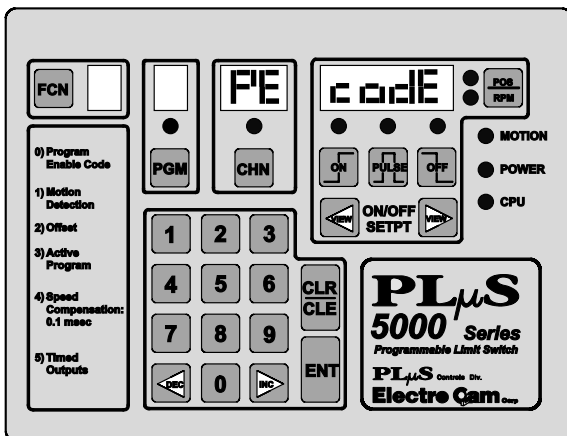
FEATURE	MASTER	SET UP	OPERATOR
Enable Method	hardware	code	hardware / code
Output Set Points	All Outputs	All Outputs	FCN 106
Output Time Out Values	All Outputs	All Outputs	FCN 106
Motion Set Points	Yes	Yes	FCN 106
Analog Setup	Yes	Yes	FCN 106
Offset	Yes	Yes	FCN 106
Active Program	Yes	Yes	FCN 106
Speed Compensation	Yes	Yes	FCN 106
FCN 106 (oper. access)	Yes	No	No
Direction of Rotation	Yes	No	No
Scale Factor	Yes	No	No
Shaft Position	Yes	No	No
Number of Analog Outs	Yes	No	No
Number of Offsets	Yes	No	No
Resolver Type	Yes	No	No
Program Select Format	Yes	No	No
Display Mode	Yes	No	No
Program Enable Codes	Yes	No	No
Motion ANDED Outputs	Yes	No	No
Output Grouping/Modes	Yes	No	No
Output Enable ANDing	Yes	No	No
Communication Setup	Yes	No	No

Hardware Program Enable Inputs

Master Programming is enabled when terminal 7 on the input terminal strip (located on left side of controller) is energized. The Master level can only be accessed by energizing this input. Operator programming is enabled when terminal 8 is energized. The Operator level can also be accessed through a keyboard enable code.

Keyboard Enable Codes for Setup and Operator Access

(See FCN 105 on page 6-6 to enter the setup and operator enable code numbers)



Either the Setup or Operator programming levels can be accessed by entering the corresponding program enable code through the keyboard. These codes can be 1, 2, 3, or 4 digit numbers and are established during Master level programming. See page 5-1.

To Enter a program enable code number press:

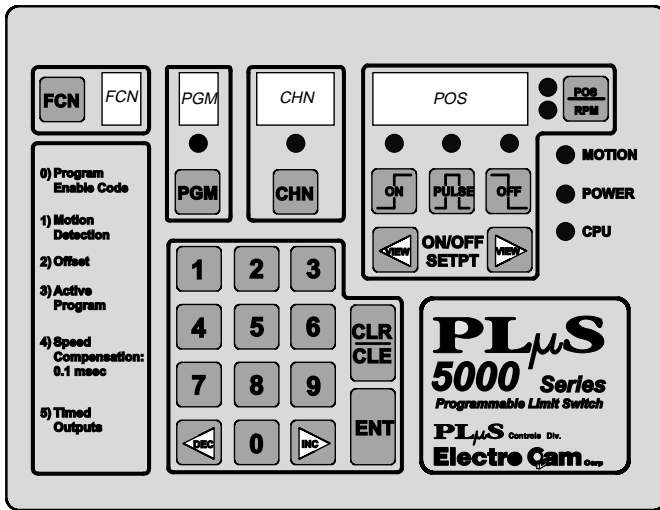
FCN 0 ENT 1st digit 2nd digit 3rd digit 4th digit ENT

The PE code message will disappear when a valid enable code is entered. The level of access gained depends upon which code number is entered.

Programming access will time-out approximately 5 minutes after the last keystroke. To cancel access before the 5 minute time-out press:

FCN 0 ENT CLR/CLE ENT

Output Setpoint Programming



Programming Error Messages

Flashing error messages indicate programming mistakes as they occur. See itemized list below.

Simply press **CLR** to cancel flashing error message.

Programming Error Messages

- E1 OLAP:** Output pulse just created/adjusted overlapped an existing output pulse in the same channel.
- E2 -run:** Attempted programming can NOT be done while machine is running (resolver is turning).
- E4 -Pro:** Program enable Off when programming was attempted.
- E5 8888:** Value entered NOT valid for item being programmed.
- E7 -dEF:** More than 25 outputs allocated in FCN 108.
- E9-tdE:** Attempted to program too many timed outputs (4 max).
- E11-ScE:** Attempted to program more than 16 speed compensated outputs.

Programming and system errors are described on pages 7-2 and 7-3.

Output Setpoint Programming

Desired output channel MUST be selected before its setpoints can be created, viewed, adjusted, or cleared.

SELECT OUTPUT CHANNEL

If POS or RPM led NOT lit press:



POS or RPM led now lit



CHN and POS displays blank



1st Digit shown in CHN display



2 Digit value in CHN display

Channel 16 used as example.

VIEW SETPOINTS

View setpoints of output channel presently selected.



ON/OFF setpoints shown in position display in increasing order with ON and OFF LEDs. 0 is shown and both LEDs off if no setpoints exist.



ON/OFF setpoints shown in position display in decreasing order with ON and OFF LEDs. 0 is shown and both LEDs off if no setpoints exist.

Note: A maximum of 512 pulses can exist in any one program. Additional pulses beyond 512 (in one program) will not be accepted by the controller.

4-6 Programming Introduction

CREATE SETPOINTS

To create setpoints in output channel presently selected.



On led lit, POS blank



1st Digit shown in POS display



2 Digits shown in POS display

On at 30 degrees used as example.



OFF led lit, POS blank



1st Digit shown in POS display



2 Digits shown in POS display



POS display blinks once to confirm setpoint entry.

Off at 60 degrees used as example.

Note: When entering multiple pulses, press **ENT** after each pulse.

CHANGE SETPOINTS

To change setpoints in output channel presently selected.

INC/DEC



Displayed ON/OFF setpoint increases 1 increment each time INC key is pressed.



Displayed ON/OFF setpoint decreases 1 increment each time DEC key is pressed.



NUMERIC ENTRY



1st Digit shown in POS display



2 Digits shown in POS display



POS display blinks once to confirm setpoint change.

Changing setpoint to 50 degrees used as example.

PULSE MODE

To change both setpoints of a pulse simultaneously.



Pulse led lit



OR



ON and OFF setpoints of ALL pulses increase/decrease 1 increment each time INC/DEC key is pressed.

MULTI-PULSE MODE

To change all setpoints in the output channel simultaneously.



Pulse led lit



Pulse led blinking



OR



ON and OFF setpoints of ALL pulses increase/decrease 1 increment each time INC/DEC key is pressed.

CLEAR SETPOINTS

CLEAR 1 PULSE

To clear 1 pulse (1 pair of setpoints) on selected output channel.

Use numeric entry method (shown in CHANGE SETPOINTS above) to set OFF setpoint equal to ON setpoint value. Both setpoints will be erased.

CLEAR EXISTING SETPOINTS

To clear all setpoints on selected output channel.



ON Led lit, POS blanks



0 shown in POS display



OFF Led lit, POS blanks



0 shown in POS display



POS display blinks and shows 0, ON and OFF leds are off.